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Consolidation processes of human capital in modern economic growth dynamics: an estimate based on the role of European corporate e-learning activities

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Abstract

In contemporary knowledge society the contribution of highly skilled human capital has become essential in those processes which aim to achieve high efficiency in input-output relationship. This therefore is a key factor being able to take advantage of high and integrated technologies into work activities, along with a workforce characterized by high levels of education and training. But the growing attention to these two forms of productive capital, tested in many empirical studies which analyze the dynamics of modern economic growth, each requiring specific and continuous investments, is also addressed in the order of another dimension instrumental to the first one. We refer to the activities of lifelong learning, and in particular to the innovative corporate e-learning activities, which have developed considerably over the last decade. The use of new technologies in the processes of education and on-the-job training would make possible to reach more advanced levels of human capital and more efficient knowledge management, with significant savings in variable costs compared to traditional education and training techniques. However these virtuous processes need initial fixed investments, and for this reason it is useful to observe the impact on the growth paths and development of the countries in which they have incurred. In this respect, our analysis focuses in particular on the relationship between European corporate e-learning activities and the active population's education levels, and afterward we observe the relationship between these variables and trend of economic growth. The first analytical approach is crucial to track how much education can be affected by new technologies applied on training, focusing mainly on the study of e-learning systems implemented by Italian enterprises. To achieve our goal we resort to the use of multivariate analysis in order to identify the ranking of countries according to their apply of corporate e-learning activities. A second approach refers to the differentiation of countries using on-the-job training systems and the dynamics of economic growth, also focusing on the evolution of corporate e-learning in order to configure the current state and carry out a potential trend estimate.

Keywords: *human capital; economic growth; corporate e-learning; forecast analysis*. *JEL classification*: C32; C53; D83; I21; O10.

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1. Introduction and background: corporate e-learning as a key driver for knowledge and competitiveness

Nowadays the central role of human capital theory lies in the increasing importance of knowledge acquired through cognitive processes more or less complex and assumed in the production system. In particular, the economic growth and competitive positioning depend, in a gradually increasing, on the quantity and quality of learning achieved, becoming the essential means by which companies acquire and manage knowledge, new source of advantage for the socio-economic system (Wild *et al.*, 2002; Rullani, 2004). Indeed, the contemporary business and social context is characterized by a high competition between organizations of various kind as well as a constantly changing and updating of living and working conditions. For these reasons it is necessary that education and training processes, which are the true engine of economic growth (Becker, 1964; Levine, 1998; Aghion and Howitt, 1998) are efficient and able to adapt to needs brought by the globalization dynamics, which concern not only the exchange of goods and services, but in general consist of a rapid and frequent dissemination of knowledge between individuals and socio-economic remote contexts. Especially in those productive sectors which invest in knowledge and continuous research and development, today there are appropriate skills and competencies, and technologies widely used, which allow to create and exploit new lever in the growth processes and those in education in detail (Foray, 2004). In this light, the next-generation corporate e-learning applications, for example, involve the use of Internet, the ability to interact and build communities of practice among workers as well as tools dedicated to specific training needs. These techniques, on closer inspection, are not intended for training only in the most advanced activities, such as the scientific and technological research, but in all cases where a constant learning and an updating knowledge of the workforce is necessary, including a large number of involved agents. In well-defined working environments, ongoing training on the one hand, also known as continuing vocational training, and just-in-time learning on the other hand, represent an effective response to the growing need for liquidity information in the sense that they make available the information and use it in an appropriate way, revealing thus indispensable to the apply of advanced technologies (see among others, Fischer 2000; Hishamuddin Harun, 2002; Wild *et al.*, 2002). Last but not least, it is important to consider the full range of potential economic benefits of corporate e-learning, which constitute three major competitive advantages: higher productivity margins, greater flexibility and therefore lower variable costs, and economies of scale arising from the possibility of continuing to repeat and duplicate content training (Abramovitz and David, 1996; Comacchio and Scapolan, 2004). It was argued by Hicks (2000) that companies in searching for cost-effective way can save about seventy percent of the budget allocated to training, if they implement in-house web-based training. In such a respect, this study aim to detect the impact of modern training systems based on e-learning, on a number of variables indicative of socio-economic analysis in a cross-country referred to the EU member states. Specifically, companies which mainly focus on this type of innovation are typical of the countries with advanced economies, which have to deal with new emerging international competitors, and to be able to beat the competition, mainly due to greater preparation and specialization. In order to develop and refine this strategic tool is essential to employ workers with high specific skills, which translate into higher productivity at work. The adoption of corporate e-learning processes, however, has not always led to adequate returns for companies which have had to support the related investments (on the effectiveness of corporate e-learning, see among others Hamid, 2002; Heilesen and Josephsen, 2008). Furthermore, even in developing countries are beginning to spread more advanced training techniques, with the goal of increasing the level of national human capital (Moussa and Moussa, 2009). In addition to the above mentioned conditions of adequacy and need for technological training, it is also essential the economic policy makers' efforts to integrate new technologies into traditional educational processes. Indeed, in order to make effective e-learning tools, substantial public and private investments are required, which should then be rewarded by improvements in economic performance at both the individual firm level that of the entire country. Even in this case the richest and most advanced economies are in the unique position to support these programs and investments, but also those that should receive more benefits from developing a national high-quality human capital. These highly specialized working staff, using innovative technologies, can bear new useful processes to science and technology, creating a virtuous cycle of growth and desirable social and economic development.

2. Analytical insights of corporate e-learning among European enterprises: the Italian case

The cross-country analysis about the implementation of corporate e-learning activities is carried out in the European context, considering a time range from 2003 to 2009. Moreover, the data we considered are based on the classification of economic activities in the European Community (NACE), as provided by Eurostat. More precisely, the data refer to firms belonging to sectors under 10_DFGHIKO which include manufacturing activities, building trade, wholesale and retail trade, hotels and restaurants, transports and infrastructures, real estate, ICT, public services. The relation we investigate is that between diffusion and use of corporate e-learning techniques and two variables representing the related economic environment. The explanatory variables we consider are: GDP real growth rate and Employment rate by Highest level of education attained. The first analysis refers to a classification of European Union Member State and other EU candidates countries according to the percentage use of e-learning in enterprises. Below are the results:

Table 1. Descriptive analysis of corporate e-learning in EU 27, from 2003 to 2009 (values in %). Source: Eurostat (2010).

Countries	Min	Max	Mean	Var	Skew	Kurt	Countries	Min	Max	Mean	Var	Skew	Kurt
Italy	4	18	12.86	26.14	-0.79	-0.02	Austria	21	30	25.43	11.29	0.18	-1.52
Denmark	8	30	19.14	97.81	0.12	-2.46	Malta	22	51	29.86	95.14	2.18	5.17
France	10	24	15.57	38.29	0.78	-1.55	Poland	22	42	30.71	54.24	0.86	-0.68
Netherl.	10	17	13.71	7.91	-0.54	-1.44	Ireland	23	41	33.43	61.29	-0.54	-2.13
Luxemb.	12	25	17.29	30.91	0.42	-2.12	Turkey	23	33	29.00	11.33	-0.81	0.60
Hungary	12	22	17.29	12.57	-0.58	-0.59	Cyprus	25	59	46.14	129.81	-1.05	1.23
Germany	14	22	18.43	8.95	-0.21	-1.48	Spain	27	35	31.29	10.24	-0.58	-1.27
Norway	14	43	29.14	112.81	-0.23	-1.25	Czech R.	30	40	33.14	12.14	1.39	2.29
Belgium	15	25	21.57	17.95	-1.09	-0.84	Slovenia	30	49	39.86	44.81	-0.46	-0.62
Iceland	17	20	18.29	1.24	0.25	-0.94	Slovakia	31	50	42.00	43.67	-0.51	-0.35
Portugal	19	36	25.86	34.48	0.76	0.00	Finland	31	41	36.57	19.62	-0.26	-2.40
Croatia	19	31	23.86	15.48	0.89	0.96	Latvia	34	43	38.86	11.14	-0.43	-1.00
Bulgary	20	41	25.86	57.81	1.68	2.35	Greece	36	53	44.86	38.48	-0.06	-1.35
Sweden	20	28	25.00	10.67	-0.84	-1.05	Lithuania	50	59	56.14	9.14	-1.66	3.07
UK	20	28	24.14	11.48	-0.35	-2.13	Romania	56	64	59.29	10.91	0.39	-2.00
Estonia	21	41	32.29	52.57	-0.39	-1.14	UE 27	20	24	22.17	2.967	-0.03	-2.36

In table 1 we report some preliminary descriptive analysis concerning the corporate e-learning activities in EU Member States. In the time range considered, the minimum percentages vary between 4% and 56%. The minimum is achieved by Italy in 2003, which placed itself at the European level with only 4% of domestic firms using e-learning applications. In the same year, however, companies established in Romania have introduced e-learning systems with a value equal to 56%. The maxima vary between 17% and 64%. In 2009, Italy reported a 18% and this result is quite satisfactory compared to the performance of other Member States, although over the years, it is possible to notice a growing trend more than proportionally. From the data we can distinguish a high variability in countries such as Denmark, Norway, Cyprus, and Malta: the high variance indicates a strong dispersion of the values related to e-learning implemented by the firms in those countries. The indices of asymmetry and kurtosis also stress distributions very particular in countries like Malta, Lithuania, and Czech Republic. These results highlight the uncertainties of the business system in adopting e-learning applications because the percentages are for a highly dispersive time range of seven years. Italy obtains a low variance and indices of symmetry and kurtosis which tend to normality, but its values in the percentages of minimum and maximum show a worse position than many other European competitors. For this reason, here we evaluate the influence of Italian corporate e-learning equipment with respect to changes in the GDP growth rate and the employment rates through regression analysis, as it turns out to be an anomalous case among all EU countries.

Table 2. Linear model for Italian corporate e-learning activities.

Model	B	Std. Error	t	Sig.		
Constant	-158.704	62.804	-2.527	.032		
Employment rate	3.694	1.385	2.668	.026	R	R Square

GDP real growth rate	-1.702	.538	-3.162	.012	.826	.682

Table 2 shows a strong direct relation between the rate of diffusion of the Italian corporate e-learning and the real GDP growth rate, and the employment rate. These results confirm a growing trend over time of corporate e-learning systems and a determination index of the model rather reasonable. The significance of the parameters resulting from regression analysis is obtained by a margin of error greater than 0.001 for the two explanatory variables studied. A more detailed analysis shows the influence of the percentage of Italian corporate e-learning trends over time. Below is the correlogram of this phenomenon, as applied with the autocorrelation function as in Priestley (1983):

$$R(s,t) = \frac{E\left[\left(X_t - \mu_t\right)\left(X_S - \mu_S\right)\right]}{\sigma_t \sigma_S} \tag{1}$$

where X_t, μ_t, σ_t respectively denote time observation, the mean and standard deviation at time t, X_S, μ_S, σ_S stands for the same observation and indicators at time *S*.

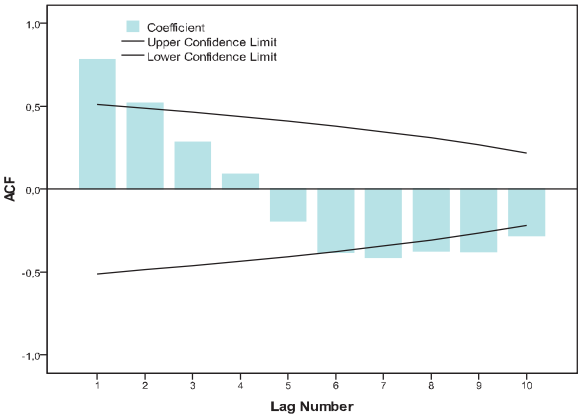

Figure 1a. Total correlogram of Italian corporate e-learning

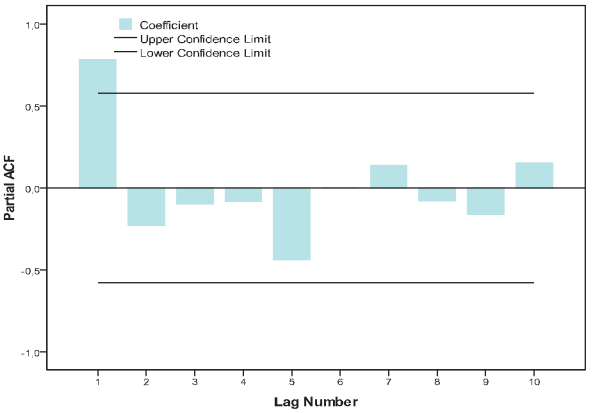

Figure 1b. Partial correlogram of Italian corporate e-learning

The total correlogram, figure 1a, shows a downward trend rather slowly over time. While the partial correlogram, figure 1b, has only the first coefficient positive and outside the confidence bands. This type of correlogram leads us to analyze the pervasiveness of Italian corporate e-learning systems with a first-order autoregressive model AR (1). Below are the results:

Table 3. First-order autoregressive model for Italian data on corporate e-learning activities.

			Estimate	SE	t	Sig.	
Corporate e-learning	Constant		-3634.684	869.193	-4.182	.004	
	AR	Lag 1	.340	.443	.768	.467	
Employment rate		Lag 0	-.234	1.500	-.156	.880	
GDP real growth rate		Lag 0	.135	.508	.267	.797	R-squared
Year		Lag 0	1.824	.458	3.980	.005	.936

The autoregressive analysis applied to the phenomenon under examination has shown an excellent result. In fact, the determination index is around to values close to unity. The parameters referred to the explanatory variables such as real GDP growth rate and the employment rate reveal a low significance, while considering the time variable we obtain a significant test with zero error. On the whole there is a strong effect of corporate e-learning systems as a

function of time, certainly due to the structural characteristics and distribution of relevant expertise and skills in the country. By using a first-order autoregressive model we perform a forward-looking analysis of e-learning systems for the next four years for the Italian context. Here are our findings:

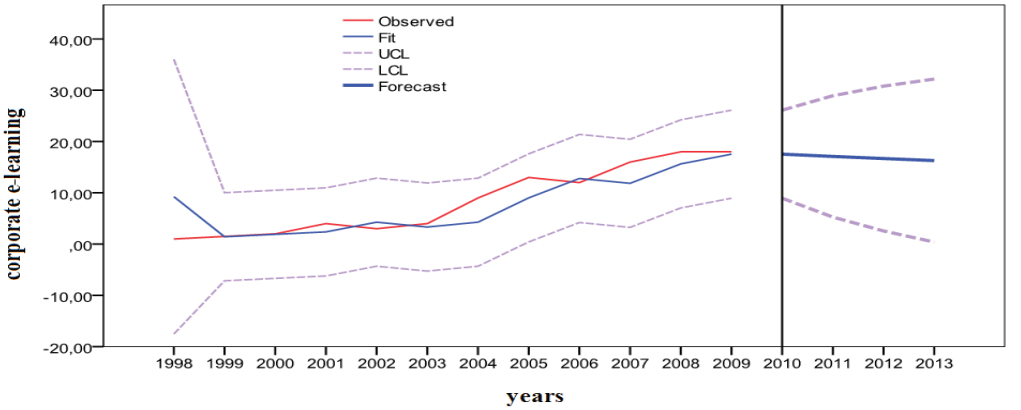

Figure 2. Observed data, theoretical and previsional Italian case with AR (1) model (data prior to 2003 have been reconstructed).

By analyzing figure 2 we can gather that is present a strong similarity of the observed values with theoretical ones. Moreover, two confidence bands related to the autoregressive model with a confidence level equal to 99% have been cross-hatched. As can be seen from the figure the values fall well within the two limits placed, confirming a proper use of the model AR (1). On the right side of the graph we have added four years of forecast, from 2010 to 2013, showing a linear progress and with a slight downward trend. In particular, from 2000 to 2004 there was a constant trend of the phenomenon, then get a slight upward trend, and reach 18% of companies operating in Italy. Note that the predictive values were calculated by taking into the autoregressive model AR (1) the two explanatory variables, GDP real growth rate and the employment rate. Through the AR (1) is clear, therefore, an adjustment even though decreasing of the configuration of corporate e-learning over the next four years.

3. Conclusive remarks

Our findings can be interpreted in the light of the results of the Economist Intelligence Unit's studies (2003, 2009). According to the e-learning readiness rankings and the IT industry competitiveness index contained in the latter analysis, the most advanced European countries rank top positions. However, in our study we observe an anomalous setting for Italy than the other EU Member State. Hence, for this country we investigate how the use of corporate e-learning techniques may have an impact on its economic growth rates and employment levels, and we study some characteristics about a possible future developments based on forecasts obtained by means of the application of modern time series models. We start from the EU 27 countries representing the current European Union and therefore includes also some of the most advanced economies in the world. Even today these countries are characterized by high dynamism and complexity under a socio-economic and especially a firms' production profile. For this reason it is necessary to develop and sustain a critical mass of national human capital, supporting the necessary training processes as well by resorting to the related use of modern ICT. Nevertheless, in order to obtain favorable effects it is necessary to combine the ability to understand the effectiveness and efficiency of new technologies and the will to spread these new tools and learning programs referred to the mentioned tools. Therefore we believe it is necessary for Italy a new plan for investments in high technologies, both public and private, starting from the education and training dimension, which will be rewarded with the acquisition of improved skills and increased productivity at work. The countries of Eastern and Northern Europe, including those with the highest rates of economic growth are those which make more use of new educational business processes defined corporate e-learning. In Italy, although it is necessary to modernize the production environment and specially to strengthen the learning techniques, there is still a situation of long delays in the deployment and use of these modern processes of

education and training, a general situation therefore which remains unsatisfactory. Indeed, the trend of both observed values and those adapted of model AR (1), representing the implementation of e-learning in the world of business and production, shows signs still weak. Our estimates confirm a linear trend, obviously influenced by the past values, particularly with a more negative worth in the most recent going. This situation produces serious limits to a development and a desirable level of economic growth in Italy, abreast of other European countries, which proved in the past to be more attentive in enhancing and entrench the knowing use and placement of new technologies.

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